



# Production of forest residues from fire safety zones and their potential for biogas production

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# Prevention of forest fires

- **Forest-fire prediction tools** (based on local meteorological data)
- **Early detection and notification tools** (thermal imaging, visual cameras, sensors)
- **Inhabitants warning system** (mobile telephony, social media, tv & radio messages)
- **Forest biomass harvesting** (leaf litter, bushes, shrubs, tree pruning, fire safety zones)



Source: [alfavita.gr](http://alfavita.gr)



Source: [aftodioikisi.gr](http://aftodioikisi.gr)



Source: [marathonpress.gr](http://marathonpress.gr)

# Forest biomass

- Forest biomass is used as a fuel since ancient times.
- Renewable energy source with neutral CO<sub>2</sub> emissions.
- Energy is often recovered by implementing thermal process (e.g. gasification) due to low ash, sulfur and nitrogen content.



Πηγή εικόνων: [www.apocalypsejohn.com](http://www.apocalypsejohn.com)



[www.agriniotimes.gr](http://www.agriniotimes.gr)



[www.zerowasteurope.eu](http://www.zerowasteurope.eu)

# Forest biomass residues

- Tree branches and leaves
- Small trees not suitable for the wood industry
- Wood processing residues (sawdust, wood chips, bark, etc)
- Low vegetation (bushes, shrubs, etc)



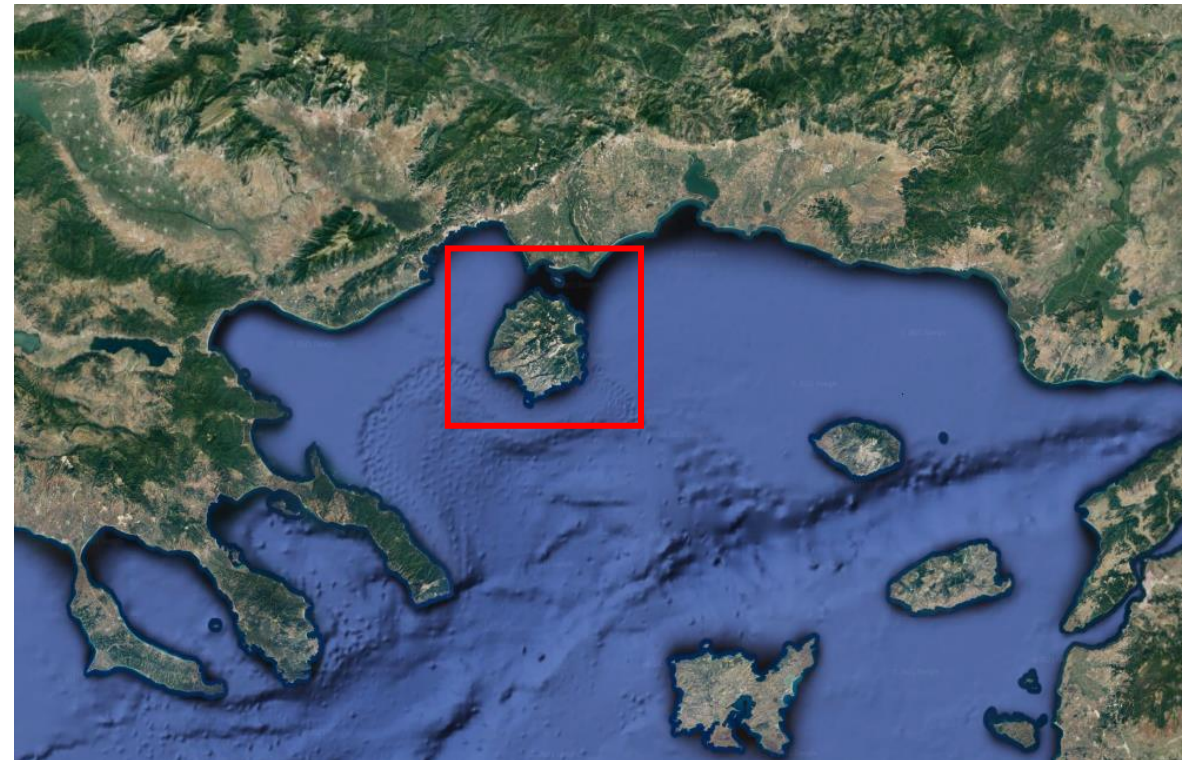
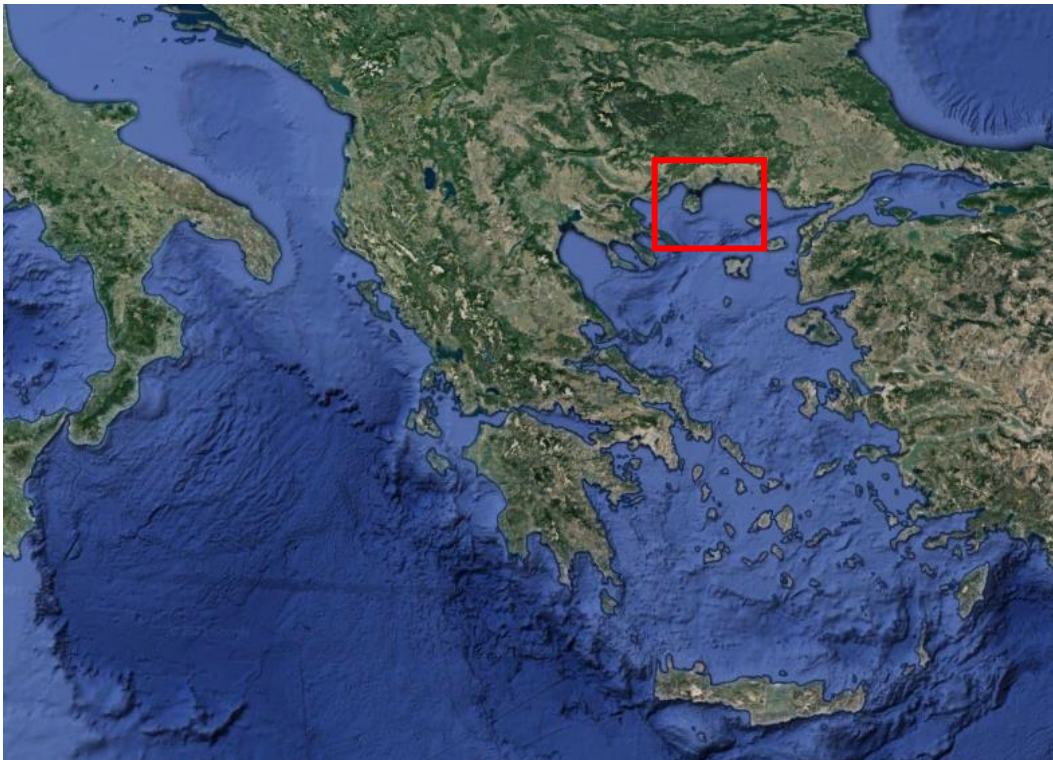
# Aim of the study

- Evaluate the type and quantity of forest biomass residues generated during typical fire safety zone maintenance
- Quantify the biogas production potential of different forest biomass residues under controlled laboratory conditions



# Study site description

- Low-altitude Mediterranean *Pinus* forest, Thasos, Greece
- “Limenas” fire safety zone



# Field studies

- Number of sampling sites = 25
- Fire safety zone width = 20 m
- Sampling site length = 10 to 20 m (area 200-400 m<sup>2</sup>)
- Monitoring: number of trees, height and diameter, vegetation cover



# Biogas production potential

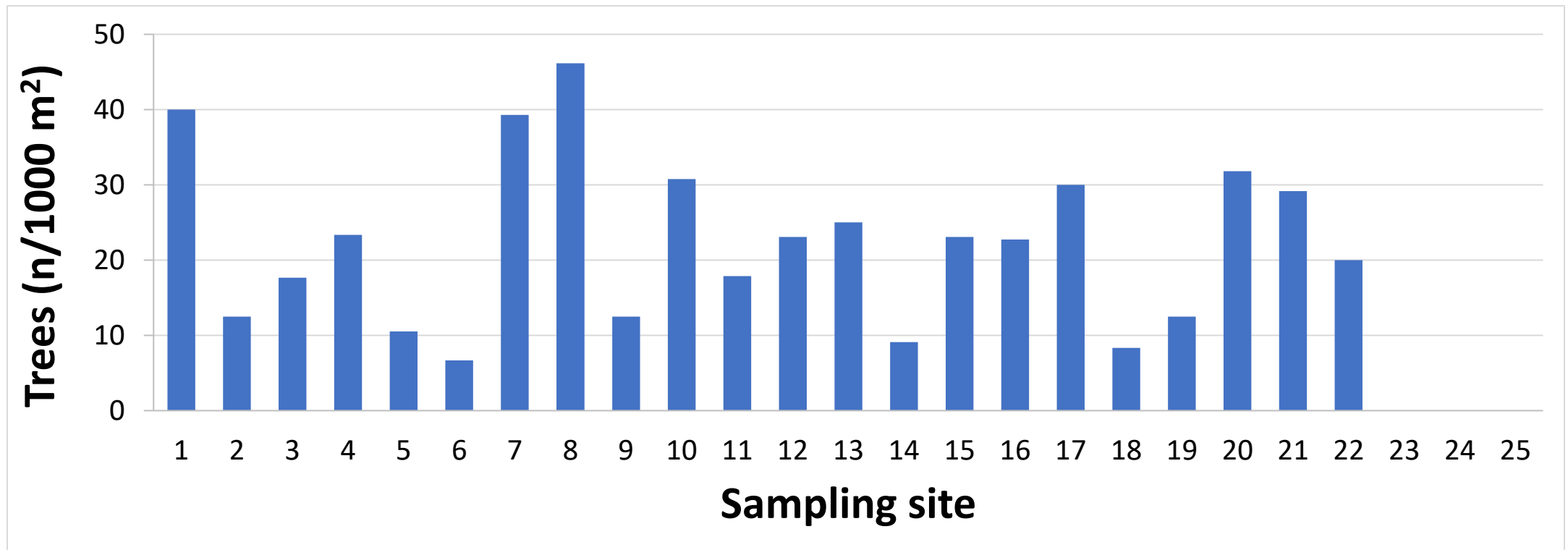
- Sample pre-treatment: grinding
- Laboratory anaerobic digesters: 150 mL working volume
- Mesophilic conditions: 38-39 °C
- Inoculum: Digested manure and energy crops





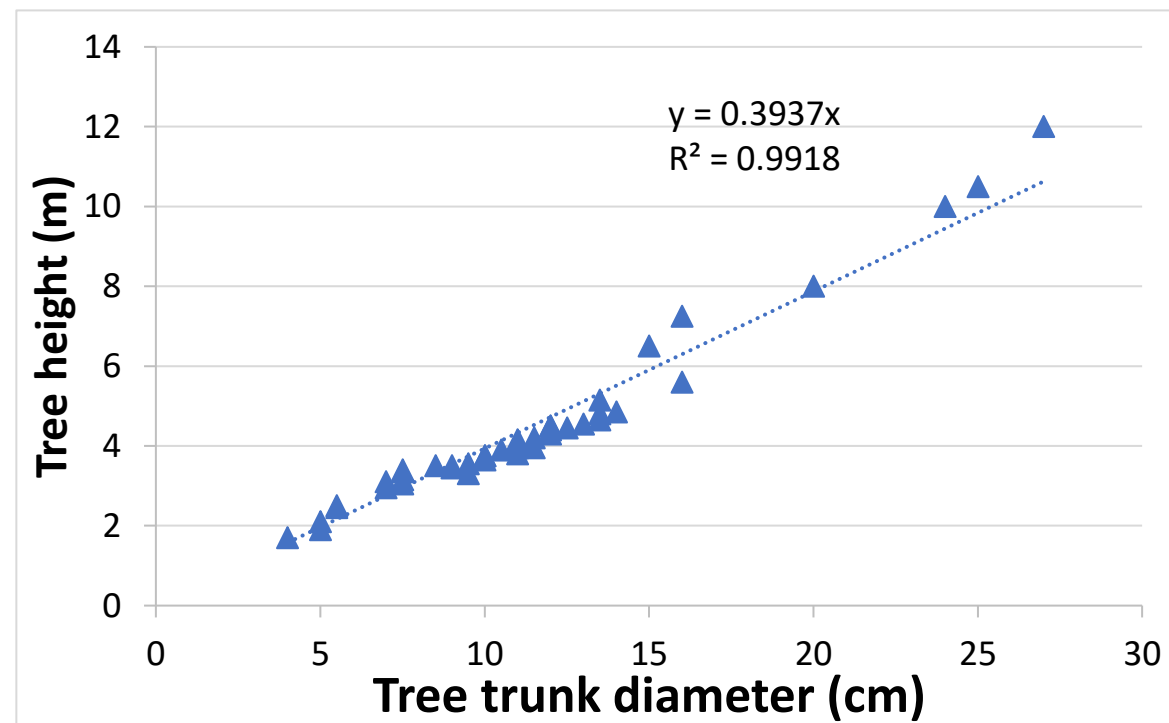
# Results – number of tree removed

- Tree removed ranged from 2 to 12 per sampling site which correspond between 5 to 45 trees per 1000 m<sup>2</sup> of fire safety zone



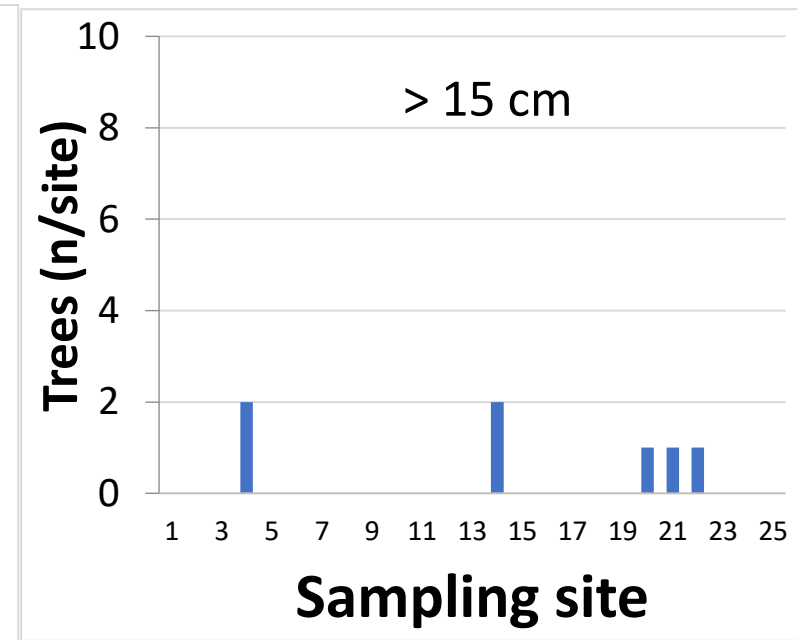
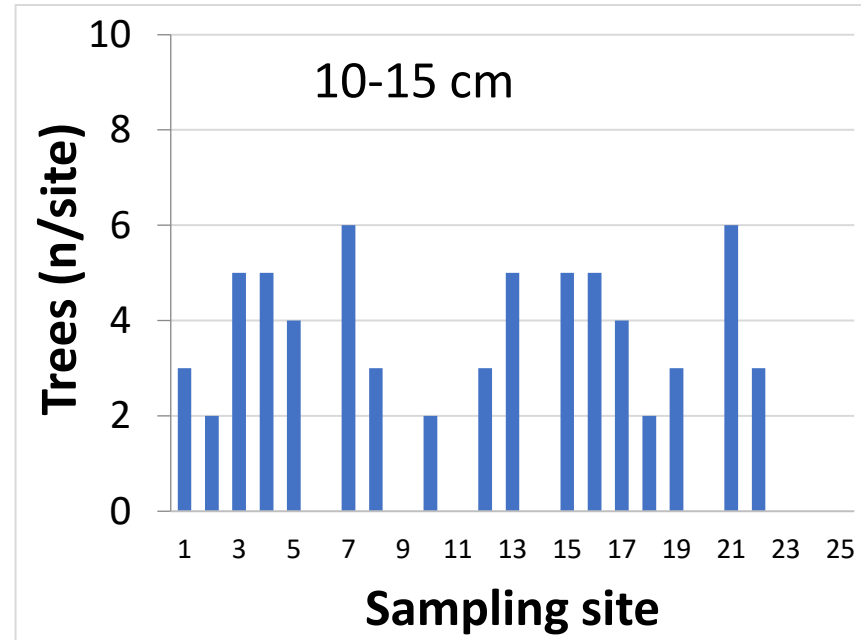
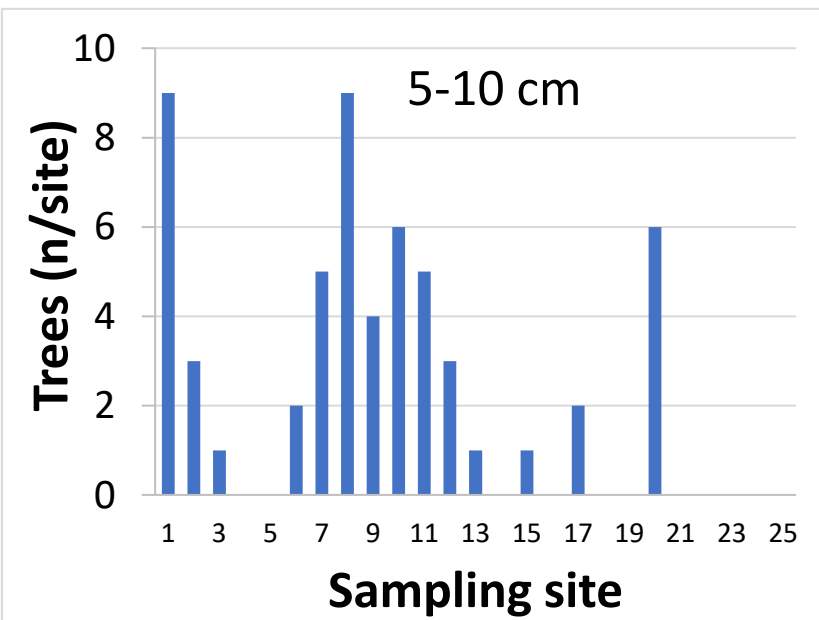
# Results –tree size

- Most of the trees grown within the fire safety zone were small in size (<5 m height) and diameter (< 15 cm).



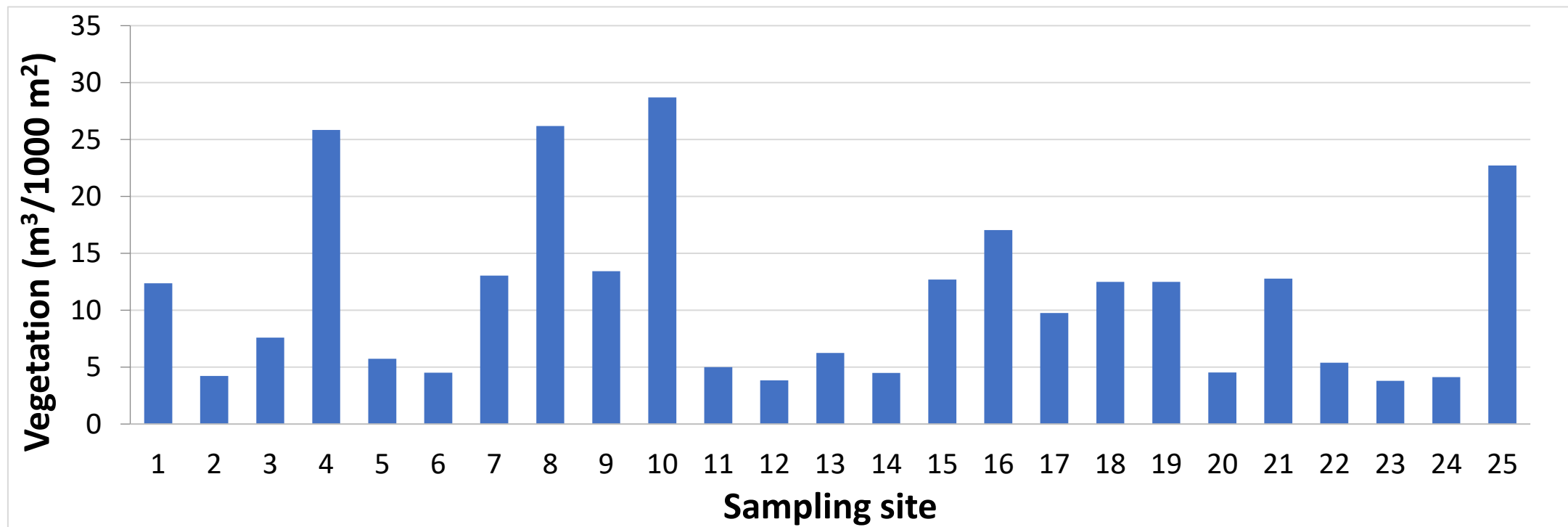
# Results – Tree trunk distribution

- Most of the trees found in the fire safety zone were young having a trunk diameter below 15 cm

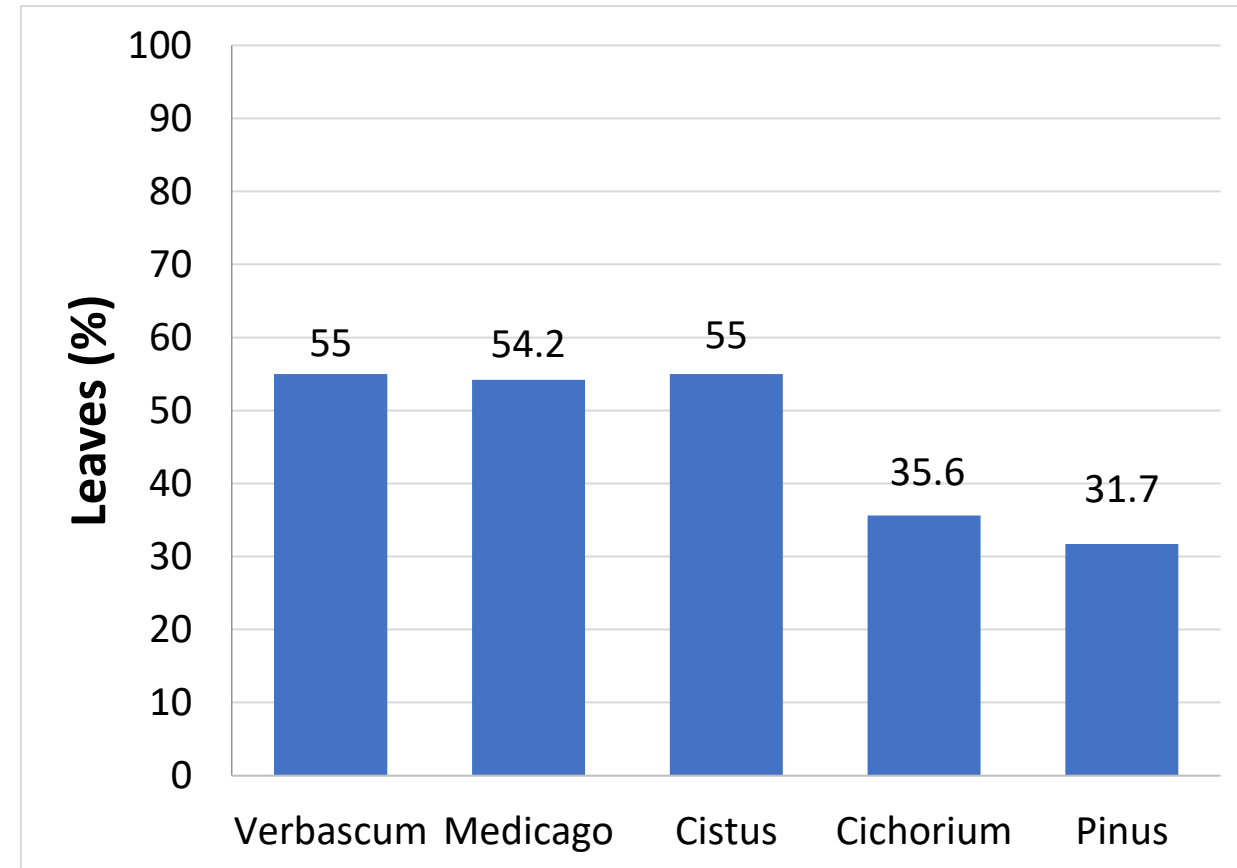
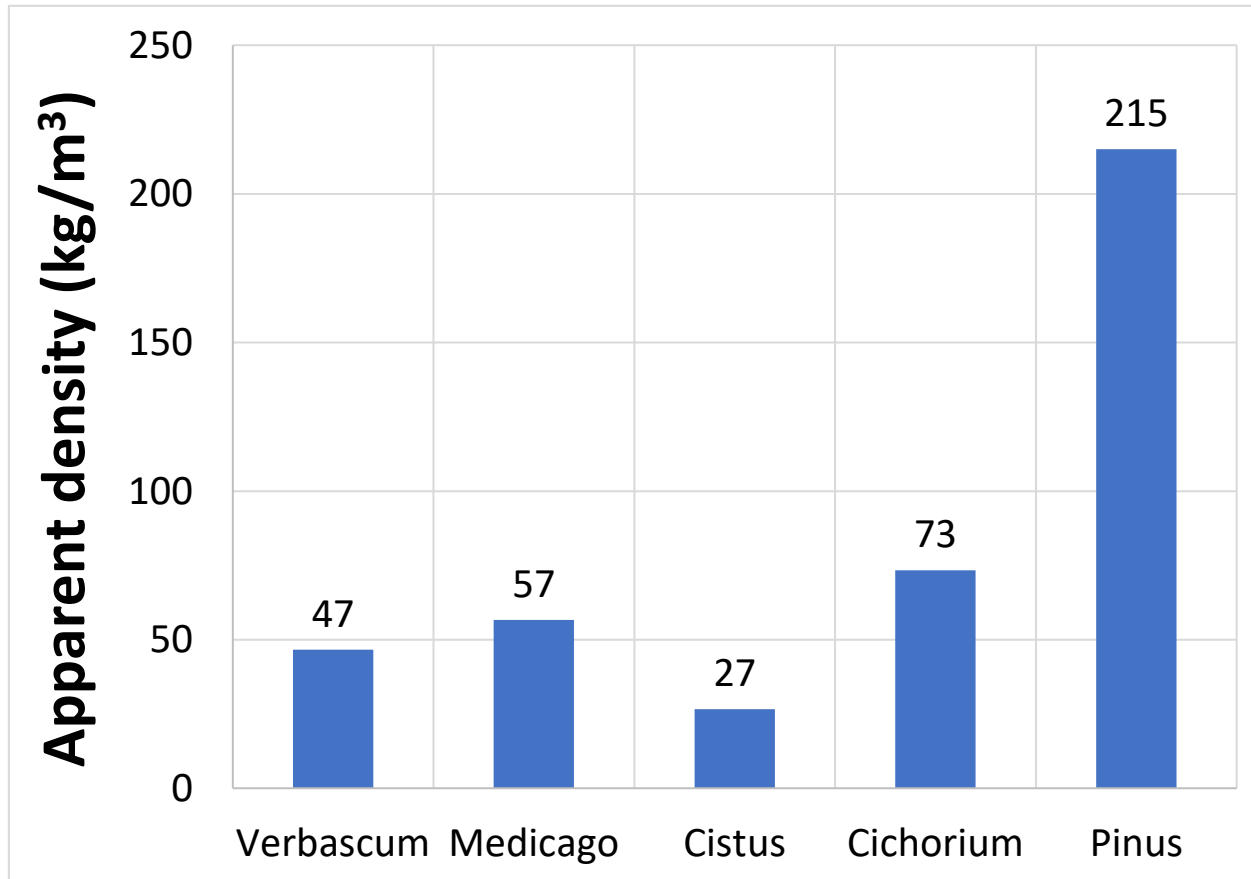


# Results – low vegetation

- The volume of tree branches and low vegetation removed varied between 1-7 m<sup>3</sup> per sampling site corresponding to 5-25 m<sup>3</sup> per 1000 m<sup>2</sup> fire safety zone

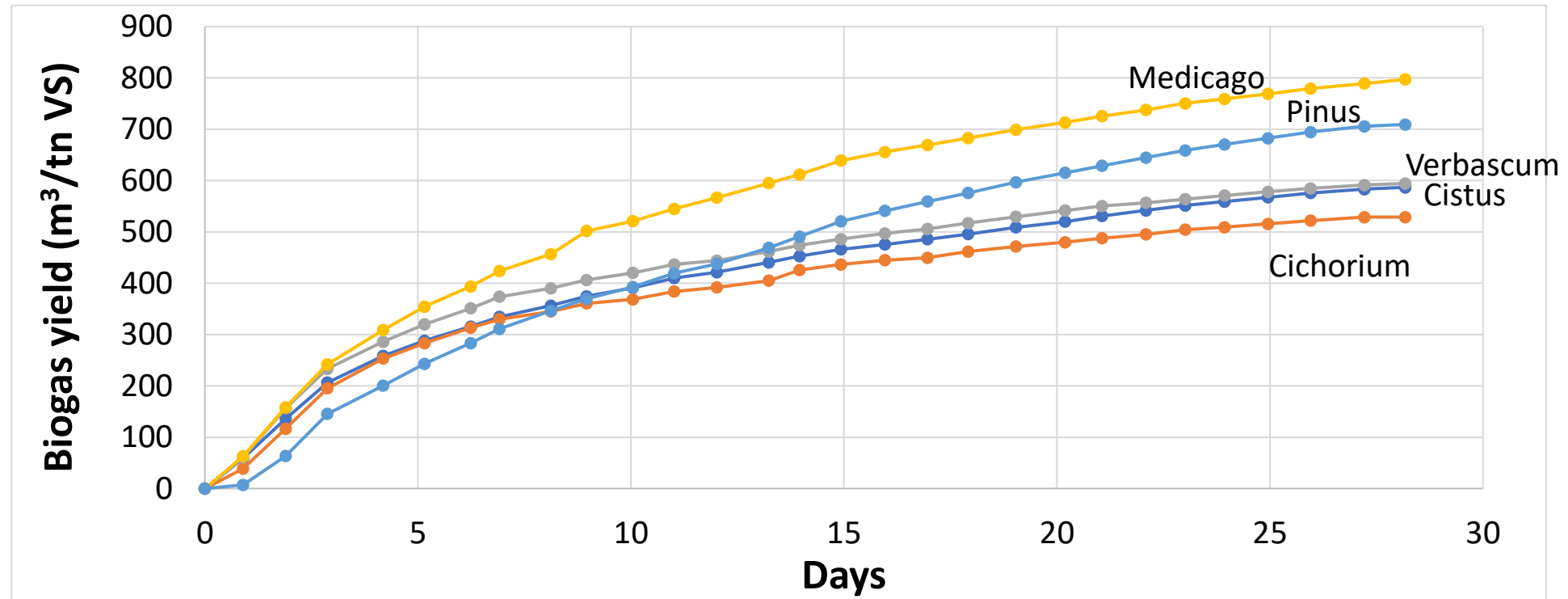


# Results – vegetation type properties



# Results – biogas production potential

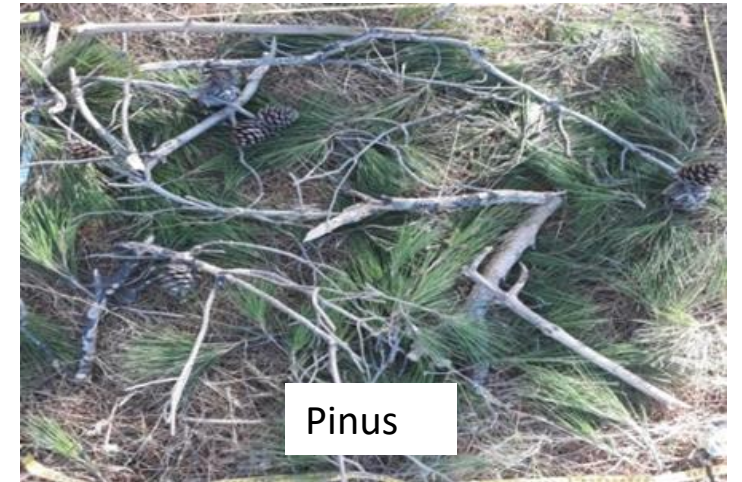
- Cumulative biogas yield of different forest biomass residues
- Biogas methane content varied between 62-67%



Sample	Biogas yield (m <sup>3</sup> /tn VS)	Methane yield (Nm <sup>3</sup> / tn VS)
Cistus	580	320
Cichorium	530	280
Verbascum	590	325
Medicago	800	410
Pinus	700	375



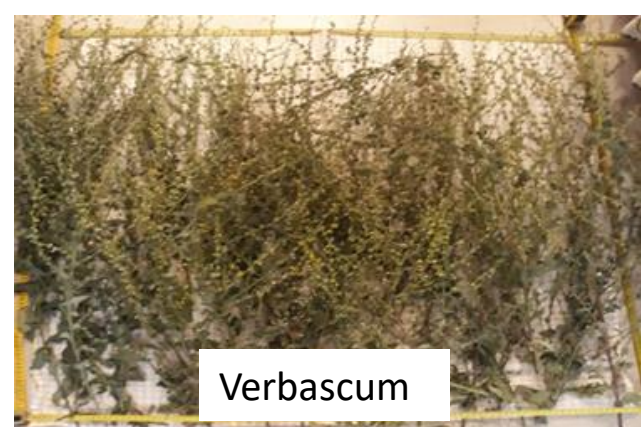
Cistus



Pinus



Cichorium



Verbascum



Medicago



Pine needles

# Conclusions

- Biomass harvesting from fire safety zones is important for wild fire management
- Pine-needles and vegetation residues are characterized by high biogas production potential can be efficiently used in anaerobic digestion facilities.
- Biogas production potential was calculated at  $200 \text{ m}^3 / 1000 \text{ m}^2$  fire safety zone
- More research is necessary to evaluate the biogas production potential of pine tree branches.
- The total area cover by fire safety zones in Thassos island is  $4,370,000 \text{ m}^2$  (437 ha).



# Acknowledgments

Thank you for your attention



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